



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017  
& ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

TRESCAL, INC  
7632 Hub Parkway  
Valley View, OH 44125  
Nathan Thrasher Phone: 216 525 0050

CALIBRATION

Valid To: March 31, 2025

Certificate Number: 2046.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1, 7</sup>:

I. Acoustical Quantities

Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
Sound Pressure Level <sup>3</sup> – Measurement Equipment	74 dB 84 dB 94 dB 104 dB 114 dB	0.41 dB 0.46 dB 0.48 dB 0.49 dB 0.42 dB	Sound level calibrator

II. Chemical Quantities

Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
pH <sup>3</sup> – Measuring Equipment	(4, 7, 10) pH	0.011 pH	Standard solutions
Conductivity <sup>3</sup> – Measuring Equipment	100 µS/cm 1000 µS/cm 10 000 µS/cm 100 000 µS/cm	2.1 µS/cm 5.1 µS/cm 38 µS/cm 350 µS/cm	Standard solutions

### III. Device Specific Parameters

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
ESD Simulator –			
Contact Discharge (Positive & Negative)	(2 to 8) kV	1.0 %	Brandenberg 139
Rise Time	(0.7 to 1) ns	0.12 ns	Oscilloscope & ESD target
30 nS Current	(2.8 to 20.8) A	1.8 %	IEC 61000-4-2
60 nS Current	(1 to 10) A	1.8 %	
EFT/Burst Generator <sup>3</sup> –			
Voltage (±)	10 V to 6 kV	2.5 %	IEC 61000-4-6
Rise Time	5 ns ± 30 %	0.81 ns	
Impulse Duration	50 ns ± 30 %	0.81 ns	Tektronix TDS 3052, Haefely PAT 50A / 1000 probes
Burst Duration	15 ms ± 20 %	0.81 ns	
Burst Period	300 ms ± 20 %	0.81 ns	
Repetition Rate:			
0.125 kV	5 kHz ± 20 %	1.2 Hz	Tektronix TDS 3052
0.25 kV	5 kHz ± 20 %	1.2 Hz	
0.50 kV	5 kHz ± 20 %	1.2 Hz	
1.0 kV	5 kHz ± 20 %	1.2 Hz	
2.0 kV	2.5 kHz ± 20 %	1.2 Hz	
4.0 kV	2.5 kHz ± 20 %	1.2 Hz	
CDN –			
Phase:			
-6 dBm	(-0.8 to 0.8)°	0.039°	CISPR 16-1-2, IEC 61000-4-6, HP8751A, Type N calibration kit
-10 dBm	(-0.12 to 0.12)°	0.035°	
-30 dBm	(-0.12 to 0.12)°	0.024°	
-40 dBm	(-0.12 to 0.12)°	0.12°	
-50 dBm	(-0.12 to 0.12)°	0.14°	
-60 dBm	(-0.3 to 0.3)°	0.70°	

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
CDN – (cont)			
Impedance	(5 to 100) Hz 100 Hz to 1 MHz (1 to 300) MHz (300 to 500) MHz	6.9 % 1.4 % 0.66 % 0.70 %	CISPR 16-1-2, IEC 61000-4-6, HP8751A, Type N calibration kit
Coupling Factor	10 kHz to 500 MHz	0.38 dB	
LISN <sup>3</sup> –			
Insertion Loss	9 kHz to 1 GHz	0.38 dB	CISPR 16-1-2
Impedance	9 kHz to 1 GHz	4.9 %	HP8751A, HP8753C verification kit
Phase	9 kHz to 1 GHz	2.8°	

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
SpO2/Pulse Oximeter –			
Beats Per Minute	60 bpm 200 bpm	1.3 bpm 2.4 bpm	Nelcor SRC-MAX
Pulse Oximetry (% SpO2) (Electrical Simulation)	(75 and 90) %	1.3 %	

#### IV. Dimensional

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Micrometers – Spindle Linearity	(0.1 to 4.0) in  (4.0 to 20) in	2.8 µin/in + 15 µin  8.4 µin/in + 26 µin	Gage blocks (Grade 00)  Gage blocks (Grade AS-1)

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Calipers			
Outside Diameter	(0.1 to 4.0) in	1.8 µin/in + 29 µin	Gage blocks (Grade 00)
	(4.0 to 20) in	7.9 µin/in + 36 µin	Gage blocks (Grade AS-1)
Step and Depth	(0.1 to 4.0) in	1.7 µin/in + 30 µin	Gage blocks (Grade 00)
	(4.0 to 20) in	7.9 µin/in + 36 µin	Gage blocks (Grade AS-1)
Inside	At 1 in	27 µin	Master ring
Indicators	Up to 2 in	1.5 µin/in + 16 µin	Gage blocks (Grade 00)
Gage Blocks	Up to 0.05 in (0.05 to 20) in	4.3 µin 3.2 µin/in + 4.3 µin	Pratt & Whitney Labmaster™
Height Gages	Up to 24 in	7.2 µin/in + 17 µin	Gage blocks (Grade 00 & AS-1)
Profilometers <sup>3</sup> – Fixed Points, Ra	16 µin 119.3 µin	3.8 µin 3.7 µin	Taylor Hobson surface standard blocks
Ring Gages	(0.04 to 14) in	(22 + 3.5D) µin	Pratt & Whitney Labmaster™
Pin Gages	(0.011 to 6) in	(3.4 + 0.94D) µin	Pratt & Whitney Labmaster™
Bore Gages – 3-Point	Up to 7.8 in	170 µin	3-point bore gage master setting

V. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
DC Voltage <sup>3</sup> – Generate	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V  (1000 to 10 000) V (10 000 to 40 000) V	7.2 μV/V + 0.50 μV 5.0 μV/V + 0.80 μV 3.5 μV/V + 2.9 μV 3.5 μV/V + 4.3 μV 5.0 μV/V + 43 μV 6.5 μV/V + 0.42 mV  0.015 % 0.041 %	Fluke 5720A      HV supply w/source voltage monitored under measure
DC Voltage <sup>3</sup> – Generate Fixed Points	100 mV 1 V 10 V 100 V 1000 V	3.5 μV/V 3.5 μV/V 3.5 μV/V 3.5 μV/V 3.5 μV/V	Ratio metric techniques Fluke 752A, Fluke 10 DC reference standard
DC Voltage <sup>3</sup> – Measure	(0 to 200) mV 200 mV to 2 V (2 to 20) V (20 to 200) V (200 to 1000) V  (1 to 10) kV  (10 to 35) kV (35 to 100) kV	7.8 μV/V + 0.10 μV 4.4 μV/V + 0.40 μV 3.6 μV/V + 4.0 μV 5.4 μV/V + 40 μV 8.2 μV/V + 0.50 mV  0.012 %  0.045 % 0.057 %	Fluke 8508A      Voltage divider & precision DMM  Precision high voltage meter
DC Current <sup>3</sup> – Measure	(0 to 200) μA 200 μA to 2.0 mA (2.0 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A  (20 to 100) A (100 to 1000) A (1000 to 3000) A	13 μA/A + 400 pA 13 μA/A + 4.0 nA 14 μA/A + 40 nA 38 μA/A + 800 nA 0.018 % + 16 μA 0.040 % + 400 μA  0.054 % 0.26 % 0.30 %	Fluke 8508A      Various current shunts

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
DC Current <sup>3</sup> – Generate	10 fA to 1 pA	2.9 %	Pico ampere source
	(1 to 10) pA	1.8 %	
	(10 to 100) pA	1.8 %	
	100 pA to 1 nA	1.8 %	
	(1 to 10) nA	1.8 %	
	(10 to 100) nA	1.7 %	
	100 nA to 110 µA	1.6 %	Fluke 5720A
	(110 to 220) µA	40 µA/A + 6.0 nA	
	220 µA to 2.2 mA	35 µA/A + 7.0 nA	
	(2.2 to 22) mA	35 µA/A + 41 nA	
	(22 to 220) mA	55 µA/A + 0.73 µA	
	220 mA to 2.2 A	0.013% + 12 µA	Fluke 5725A amplifier
	(2.2 to 11) A	0.036% + 0.49 mA	
(11 to 20) A	0.011 % + 1.0 mA		
(20 to 120) A	90 µA/A + 6.0 mA	Fluke 52120A	
(120 to 1000) A	0.26 %		
(1000 to 5000) A	0.56 %	1 kA shunt Fluke 52120A w/current coils	



Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate			
Up to 2.2 mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 4.0 μV 90 μV/V + 4.0 μV 80 μV/V + 4.0 μV 0.020 % + 4.0 μV 0.050 % + 5.0 μV 0.11 % + 10 μV 0.14 % + 20 μV 0.27 % + 20 μV	Fluke 5720A
(2.2 to 22) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 4.5 μV 90 μV/V + 4.2 μV 80 μV/V + 4.2 μV 0.020 % + 4.4 μV 0.050 % + 6.1 μV 0.11 % + 12 μV 0.14 % + 23 μV 0.27 % + 26 μV	
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 17 μV 90 μV/V + 9.0 μV 80 μV/V + 8.8 μV 0.020 % + 11 μV 0.046 % + 27 μV 0.090 % + 41 μV 0.14 % + 57 μV 0.27 % + 0.11 mV	
220 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz (40 to 20 000) Hz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 94 μV 89 μV/V + 36 μV 40 μV/V + 19 μV 75 μV/V + 27 μV 0.011 % + 55 μV 0.042 % + 0.17 mV 0.094 % + 0.58 mV 0.17 % + 0.68 mV	
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz (40 to 20 000) Hz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 0.94 mV 90 μV/V + 0.36 mV 45 μV/V + 0.16 mV 75 μV/V + 0.27 mV 0.010 % + 0.43 mV 0.028 % + 12 mV 0.10 % + 4.2 mV 0.15 % + 6.6 mV	

Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate (cont)			
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz (40 to 20 000) Hz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 9.4 mV 90 μV/V + 3.6 mV 47 μV/V + 1.7 mV 52 μV/V + 3.6 mV 0.015 % + 6.3 mV 0.090 % + 36 mV 0.44 % + 0.14 V 0.80 % + 0.26 V	Subject to 2.2 E <sup>7</sup> V-Hz limitation
(220 to 1100) V	(15 to 50) Hz (0.05 to 1) kHz	0.030 % + 82 mV 70 μV/V + 19 mV	
1100 V	40 Hz to 1.0 kHz (1 to 20) kHz (20 to 30) kHz	90 μV/V + 24 mV 0.016 % + 43 mV 0.060 % + 0.15 V	5725A amplifier
750 V	(30 to 50) kHz (50 to 100) kHz	0.060 % + 0.15 V 0.23 % + 0.56 V	5725A amplifier
AC Voltage <sup>3</sup> – Measure			
(0 to 200) mV	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.016 % + 13 μV 0.012 % + 4.0 μV 0.010 % + 4.1 μV 0.010 % + 2.1 μV 0.013 % + 4.1 μV 0.031 % + 8.0 μV 0.067 % + 19 μV	Fluke 8508A
(0.2 to 2) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz	0.015 % + 0.15 mV 0.011 % + 30 μV 88 μV/V + 28 μV 74 μV/V + 26 μV 0.011 % + 31 μV 0.013 % + 0.27 mV 0.051 % + 0.24 mV 0.23 % + 2.1 mV	



Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure (cont)			
(2 to 20) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.016 % + 0.24 mV 0.012 % + 0.11 mV 78 µV/V + 0.29 mV 74 µV/V + 40 µV 0.011 % + 72 µV 0.021 % + 0.10 mV	Fluke 8508A
(20 to 200) V	(30 to 100) kHz (100 to 300) kHz	0.051 % + 0.25 mV 0.23 % + 2.1 mV	
(200 to 1000) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz	0.016 % + 11 mV 0.012 % + 2.0 mV 90 µV/V + 2.0 mV 76 µV/V + 1.9 mV 0.011 % + 2.0 mV 0.021 % + 4.1 mV 0.051 % + 19 mV 0.23 % + 0.19 V	
(1 to 10) kV	(1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.015 % + 67 mV 0.011 % + 26 mV 0.011 % + 26 mV 0.020 % + 49 mV 0.054 % + 0.21 V	
(10 to 30) kV	(0.01 to 1) Hz (1 to 200) Hz (200 to 450) Hz	0.14 % 0.14 % 0.41 %	Precision high voltage meter
(30 to 70) kV	(0.01 to 1) Hz (1 to 200) Hz (200 to 450) Hz	0.14 % 0.08 % 0.52 %	
(70 to 100) kV	(0.01 to 1) Hz (1 to 70) Hz (70 to 200) Hz	0.32 % 0.15 % 1.1 %	
	(50 to 60) Hz	0.66 %	AC voltage standard w/ voltage divider & precision DMM

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
AC Current <sup>3</sup> – Generate			
Up to 220 µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.014 % + 63 nA 0.016 % + 12 nA 0.012 % + 9.4 nA 0.028 % + 15 nA 0.11 % + 77 nA	Fluke 5720A
220 µA to 2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 97 nA 0.016 % + 72 nA 0.012 % + 62 nA 0.020 % + 0.16 µA 0.11 % + 0.90 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 0.96 µA 0.016 % + 0.73 µA 0.012 % + 0.62 µA 0.020 % + 1.0 µA 0.11 % + 7.4 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 9.8 µA 0.016 % + 7.3 µA 0.012 % + 5.2 µA 0.020 % + 8.0 µA 0.11 % + 34 µA	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.026 % + 93 µA 0.045 % + 0.18 mA 0.70 % + 1.5 mA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.046 % + 1.2 mA 0.095 % + 2.5 mA 0.36 % + 8.7 mA	Fluke 5720A w/5725 amplifier
(11 to 20.5) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.11 % + 5.0 mA 0.12 % + 5.0 mA 2.4 % + 5.0 mA	
(20.5 to 100) A	1 kHz 10 kHz 30 kHz 100 kHz	84 µA/A 0.012 % 0.013 % 0.024 %	Fluke A40B-100A
(100 to 550) A	(45 to 440) Hz	0.36 %	Fluke 5520A w/coil
(550 to 3000) A	10 Hz to 1 kHz	0.56 %	Fluke 52120A w/current coils
(3 to 6) kA	10 Hz to 1 kHz	0.56 %	

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
AC Current <sup>3</sup> – Measure			
Up to 200 µA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.034 % + 20 nA 0.035 % + 20 nA 0.068 % + 20 nA 0.57 % + 20 nA	Fluke 8508A
200 µA to 2 mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.033 % + 200 nA 0.029 % + 200 nA 0.066 % + 200 nA 0.40 % + 200 nA	
(2 to 20) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.034 % + 2.0 µA 0.030 % + 2.0 µA 0.066 % + 2.0 µA 0.40 % + 2.0 µA	
(20 to 200) mA	(1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.033 % + 20 µA 0.026 % + 20 µA 0.061 % + 20 µA	
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz	0.061 % + 200 µA 0.072 % + 200 µA 0.30 % + 200 µA	
(2 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.091 % + 2.4 mA 0.26 % + 2.4 mA	
(20 to 100) A (100 to 1000) A	(0 to 100) Hz (0 to 100) Hz	0.054 % 0.30 %	
(1 to 1.2) kA (1.2 to 3) kA	(0 to 100) Hz (0 to 100) Hz	0.17 % 0.30 %	Various current shunts

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
Resistance <sup>3</sup> – Generate			
Ranges	(1.00 to 1000) MΩ (1000 to 10 000) MΩ (10 to 100) GΩ	0.24 % 0.70 % 1.5 %	Biddle 72-6346-1
Fixed Points	0.001 Ω 0.01 Ω 0.1 Ω	0.056 % 0.049 % 0.040 %	Current shunt
	1.0 Ω	0.17 μΩ/Ω	Fluke 742A-1
	100 Ω	0.80 μΩ/Ω	Fluke 742-100
	10 kΩ	0.33 μΩ/Ω	Fluke 742A-10k
	0 Ω	50 μΩ	Fluke 5720A
	1 Ω	0.11 mΩ	
	1.9 Ω	0.21 mΩ	
	10 Ω	0.27 mΩ	
	19 Ω	0.52 mΩ	
	100 Ω	1.2 mΩ	
	190 Ω	2.3 mΩ	
	1 kΩ	10 mΩ	
	1.9 kΩ	19 mΩ	
	10 kΩ	0.10 Ω	
	19 kΩ	0.19 Ω	
	100 kΩ	1.3 Ω	
	190 kΩ	2.5 Ω	
	1 MΩ	23 Ω	
	1.9 MΩ	46 Ω	
	10 MΩ	0.46 kΩ	
	19 MΩ	1.1 kΩ	
	100 MΩ	0.011 %	
	10 MΩ	0.14 %	Keithley 5155-7
	100 MΩ	0.14 %	Keithley 5155-8
	1 GΩ	0.14 %	Keithley 5155-9
	10 GΩ	0.16 %	Keithley 5155-10
	100 GΩ	0.59 %	Keithley 5155-11
	1 TΩ	2.1 %	Keithley 5155-12

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
Resistance <sup>3</sup> – Measure	(0 to 0.25) Ω	60 μΩ/Ω	Hart Scientific 1590
	(0.25 to 4.0) Ω	47 μΩ/Ω	
	(2.5 to 40) Ω	24 μΩ/Ω	
	(0 to 25) Ω	8.7 μΩ/Ω	
	(25 to 400) Ω	7 μΩ/Ω	
	(400 to 1000) Ω	13 μΩ/Ω	
	(1 to 25) kΩ	15 μΩ/Ω	
	(25 to 40) kΩ	14 μΩ/Ω	
	(40 to 100) kΩ	41 μΩ/Ω	
	(100 to 500) kΩ	0.015 %	
	(2 to 20) kΩ	7.7 μΩ/Ω + 5.0 mΩ	Fluke 8508A
	(20 to 200) kΩ	8 μΩ/Ω + 50 mΩ	
(0.2 to 2) MΩ	10 μΩ/Ω + 1.0 Ω		
(2 to 20) MΩ	23 μΩ/Ω + 100 Ω		
(20 to 200) MΩ	77 Ω/Ω + 10 kΩ		
(0.2 to 2) GΩ	0.063 % + 1.0 MΩ	Quadtech 1865	
(2 to 100) GΩ	0.55 %		
(100 to 1000) GΩ	0.54 %		

Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments	
Harmonic Distortion (2 <sup>nd</sup> to 60 <sup>th</sup> ) – Generate	(33 to 330) mV	(10 to 45) Hz 45 Hz to 5.0 kHz	Fluke 5520A	
				0.24 μV/V + 0.021 mV 0.096 μV/V + 0.027 mV
	(0.33 to 3.3) V	(10 to 45) Hz 45 Hz to 5.0 kHz		0.24 mV/V + 0.16 mV 0.12 mV/V + 0.14 mV
	(3.3 to 33) V	(10 to 45) Hz 45 Hz to 5.0 kHz		0.24 mV/V + 1.8 mV 0.12 mV/V + 1.4 mV
	(33 to 330) V	45 Hz to 1.0 kHz (1.0 to 5.0) kHz		0.15 mV/V + 8.4 mV 0.16 mV/V + 15 mV
(330 to 1020) V	45 Hz to 1.0 kHz (1.0 to 5.0) kHz	0.24 mV/V + 96 mV 0.20 mV/V + 83 mV		

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments	
Harmonic Distortion – Measure	20 Hz to 20 kHz Fundamental Frequency	(2 <sup>nd</sup> to 64 <sup>th</sup> ) Harmonic, where frequency x harmonic ≤ 50 kHz	0.13 %	Keithley 2016-P
		Total Harmonic Distortion	0.13 %	
20 kHz to 26.5 GHz	(0.10 to 9.0) kHz	0.87 dB	Agilent E4407B	
	9.0 kHz to 3.0 GHz	0.84 dB		
	(3.0 to 6.7) GHz	1.9 dB		
	(6.7 to 26.5) GHz	2.4 dB		

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments	
Electrical Calibration of Thermocouples <sup>3</sup> – Generate & Measure	Type B	(600 to 800) °C	0.34 °C	Fluke 5520A
		(800 to 1000) °C	0.26 °C	
		(1000 to 1550) °C	0.23 °C	
		(1550 to 1820) °C	0.26 °C	
	Type C	(0 to 150) °C	0.23 °C	
		(150 to 650) °C	0.20 °C	
		(650 to 1000) °C	0.24 °C	
		(1000 to 1800) °C	0.39 °C	
		(1800 to 2316) °C	0.66 °C	
	Type E	(-250 to -100) °C	0.39 °C	
		(-100 to -25) °C	0.13 °C	
		(-25 to 350) °C	0.11 °C	
		(350 to 650) °C	0.13 °C	
		(650 to 1000) °C	0.16 °C	
	Type J	(-210 to -100) °C	0.21 °C	
		(-100 to -30) °C	0.13 °C	
(-30 to 150) °C		0.11 °C		
(150 to 760) °C		0.13 °C		
(760 to 1200) °C		0.18 °C		

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of Thermocouples <sup>3</sup> – Generate & Measure (cont)			
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.26 °C 0.14 °C 0.12 °C 0.20 °C 0.31 °C	Fluke 5520A
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.29 °C 0.20 °C 0.14 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.31 °C 0.17 °C 0.15 °C 0.14 °C 0.21 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.44 °C 0.27 °C 0.26 °C 0.31 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.37 °C 0.28 °C 0.29 °C 0.36 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.49 °C 0.19 °C 0.13 °C 0.11 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.44 °C 0.21 °C	

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of RTDs <sup>3</sup> – Measure & Generate			
Type Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.047 °C 0.055 °C 0.075 °C 0.078 °C 0.11 °C 0.18 °C	Fluke 5520A 4 wire compensation
Type Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.045 °C 0.056 °C 0.071 °C 0.081 °C 0.093 °C	
Type Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.19 °C 0.034 °C 0.042 °C 0.049 °C 0.062 °C 0.063 °C 0.072 °C 0.078 °C 0.18 °C	
Type Pt 385, 200 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.047 °C 0.034 °C 0.039 °C 0.047 °C 0.093 °C 0.10 °C 0.11 °C 0.12 °C	
Type Pt 385, 500 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.039 °C 0.041 °C 0.042 °C 0.049 °C 0.064 °C 0.064 °C 0.085 °C 0.085 °C	



Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
Electrical Calibration of RTDs <sup>3</sup> – Measure & Generate (cont)			
Type Pt 385, 1000 Ω	(-200 to -80) °C	0.035 °C	Fluke 5520A 4 wire compensation
	(-80 to 0) °C	0.027 °C	
	(0 to 100) °C	0.035 °C	
	(100 to 260) °C	0.042 °C	
	(260 to 300) °C	0.047 °C	
	(300 to 400) °C	0.056 °C	
	(400 to 600) °C	0.060 °C	
	(600 to 630) °C	0.18 °C	
Type PtNi, 120 Ω (Ni 120)	(-80 to 0) °C	0.063 °C	
	(0 to 100) °C	0.063 °C	
	(100 to 260) °C	0.11 °C	
Type Cu 427, 10 Ω	(-100 to 260) °C	0.23 °C	

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
Capacitance <sup>3</sup> – Generate			
Fixed Points:	1 kHz	14 μF/F	GenRad 1404-A GenRad 1404-B
	1 kHz	16 μF/F	
1 pF	100 Hz to 1 kHz	45 μF/F	HP 1638XX standard capacitor
	1 kHz to 1 MHz	91 μF/F	
	(1 to 2) MHz	0.023 %	
	(2 to 3) MHz	0.042 %	
	(3 to 4) MHz	0.064 %	
	(4 to 5) MHz	0.089 %	
	(5 to 10) MHz	0.25 %	
	(10 to 13) MHz	0.37 %	
10 pF	100 Hz to 1 kHz	39 μF/F	
	1 kHz to 1 MHz	39 μF/F	
	(1 to 2) MHz	40 μF/F	
	(2 to 3) MHz	44 μF/F	
	(3 to 4) MHz	47 μF/F	
	(4 to 5) MHz	57 μF/F	
	(5 to 10) MHz	0.013 %	
	(10 to 13) MHz	0.016 %	

Parameter/Range	Frequency	CMC <sup>2,5,6</sup> (±)	Comments
Capacitance <sup>3</sup> – Generate (cont)			
Fixed Points: 100 pF	100 Hz to 1 kHz 1 kHz to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	39 μF/F 40 μF/F 48 μF/F 68 μF/F 94 μF/F 0.014 % 0.033 % 0.051 %	HP 1638XX standard capacitor
1000 pF	100 Hz to 1 kHz 1 kHz to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	41 μF/F 64 μF/F 0.015 % 0.028 % 0.044 % 0.061 % 0.19 % 0.28 %	GenRad 1409 series
0.001 μF 0.01 μF 0.1 μF 1.0 μF 0.02 μF 0.005 μF 0.05 μF 1000 pF 100 PF	20 Hz to 1 kHz 20 Hz to 1 kHz 20 Hz to 1 kHz 20 Hz to 1 kHz 20 Hz to 1 kHz 20 Hz to 1 kHz 20 Hz to 1 kHz 1 kHz 1 kHz	1.2 pF 13 pF 120 pF 1.1 nF 23 pF 7.1 pF 56 pF 14 μF/F 16 μF/F	GenRad 1404-A GenRad 1404-B
(0.19 to 0.3999) nF (0.4 to 1.0999) nF (1.1 to 3.29) nF (3.3 to 10.9) nF (11 to 32.9999) nF (33 to 109.9) nF (110 to 329.999) nF (0.33 to 1.09) μF (1.1 to 3.299 99) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.999) μF (110 to 329.999) μF (0.3 to 1.099 99) mF (1.1 to 3.2999) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (10 to 50) Hz (10 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	0.51 % + 0.010 nF 0.51 % + 0.010 nF 0.51 % + 0.010 nF 0.27 % + 0.010 nF 0.27 % + 0.10 nF 0.27 % + 0.10 nF 0.27 % + 0.30 nF 0.27 % + 1.0 nF 0.27 % + 3.0 nF 0.27 % + 10 nF 0.41 % + 30 nF 0.46 % + 100 nF 0.46 % + 300 nF 0.46 % + 1.0 μF 0.46 % + 3.0 μF 0.46 % + 10 μF 0.76 % + 30 μF 1.1 % + 100 μF	Fluke 5520A

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
Capacitance <sup>3</sup> – Measure			
Fixed Points:			Agilent E4980A
1 pF	(0.1 to 1) kHz (1 to 10) kHz	12 % 1.2 %	
10 pF	(20 to 1000) Hz (1 to 10) kHz (10 to 100) kHz (0.1 to 2) MHz	12 % 1.2 % 0.13 % 0.35 %	
100 pF	(20 to 100) Hz (0.1 to 1) kHz 1.0 kHz to 2 MHz	12 % 1.2 % 0.12 %	
1 nF	(20 to 100) Hz 100 Hz to 1 MHz (1 to 2) MHz	1.2 % 0.12 % 0.36 %	
10 nF	(20 to 100) Hz 100 Hz to 100 kHz 100 kHz to 2 MHz	0.35 % 0.12 % 0.35 %	
100 nF	20 Hz to 10 kHz 10 kHz to 2 MHz	0.12 % 0.35 %	
1.0 μF	20 Hz to 10 kHz 10 kHz to 2 MHz	0.12 % 0.35 %	
10.0 μF	(20 to 1000) Hz (1 to 100) kHz (0.1 to 2) MHz	0.12 % 0.35 % 1.2 %	
100.0 μF	100 Hz to 10 kHz (10 to 100) kHz (0.1 to 1) MHz (1 to 2) MHz	0.35 % 1.2 % 7.0 % 12 %	
1.0 mF	(20 to 1000) Hz (1 to 10) kHz (10 to 100) kHz (0.1 to 1) MHz	0.35 % 1.2 % 7.0 % 12 %	
10 mF	(20 to 100) Hz (0.1 to 1) kHz (1 to 10) kHz (10 to 100) kHz	0.81 % 1.2 % 9.3 % 12 %	

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
Capacitance <sup>3</sup> – Measure (cont)			
Fixed Points:			
100 mF	(20 to 100) Hz 100 Hz to 10 kHz	5.8 % 12 %	Agilent E4980A

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
Inductance <sup>3</sup> – Generate @ 1000 Hz, Generate Equipment	100 µH to 1.111 H (100 µH Steps)	2.4 %	GenRad 1490-F decade inductance box
Fixed Points	200 µH 500 µH 1 mH 5 mH 10 mH 50 mH 500 mH 2 H	0.15 % 0.15 % 0.15 % 0.15 % 0.15 % 0.15 % 0.15 % 0.15 %	GenRad 1482-x standard inductors

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
Inductance <sup>3</sup> – Measure			
1 pH to 1 mH	(20 to 100) Hz (0.1 to 1) kHz (1 to 10) kHz (10 to 100) kHz (0.1 to 1) MHz (1 to 2) MHz	0.35 % 0.12 % 0.12 % 0.12 % 0.12 % 0.41 %	Agilent E4980A
(1 to 10) mH	(20 to 100) Hz (0.1 to 1) kHz (1 to 10) kHz (10 to 100) kHz (0.1 to 1) MHz (1 to 2) MHz	0.35 % 0.12 % 0.14 % 0.12 % 0.12 % 1.7 %	

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
Inductance <sup>3</sup> – Measure (cont)			
(10 to 100) mH	(20 to 100) Hz (0.1 to 1) kHz (1 to 10) kHz	0.35 % 0.12 % 0.12 %	Agilent E4980A
100 mH to 1 H	(20 to 100) Hz (0.1 to 1) kHz (1 to 10) kHz	0.12 % 0.12 % 0.12 %	
(1 to 10) H	(20 to 100) Hz (0.1 to 1) kHz	0.12 % 0.12 %	
Oscilloscopes <sup>3</sup> –			
Voltage (50 Ω)	(1 to 556) mV 556 mV to 5.56 V	0.078 % + 10 μV 0.78 % + 10 μV	Fluke 9500B w/ Fluke heads 9630 & 9560
Sweep Time	9 ns to 55 s	2.3 μs/s	
Rise Time	150 ps to 100 ms	16 ps	
Bandwidth	0.1 Hz to 6.0 GHz	4.4 % flatness	
Phase Angle <sup>3</sup> – Generate			
(0 to 360)°	(10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.079° 0.19° 0.39° 2.0° 3.9° 7.8°	Fluke 5520A

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
DC Power – Generate			
Up to 1020 V	Up to 3.0 W (3.0 to 30) W (30 to 300) W (0.3 to 3.0) kW (3.0 to 20.9) kW	0.017 % 0.014 % 0.014 % 0.033 % 0.085 %	Fluke 5520A

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
AC Power – Generate  (45 to 65) Hz Power Factor = 1 Up to 1020 V	Up to 33 W (33 to 330) W (0.33 to 1.1) kW (1.1 to 3.0) kW (3.0 to 11) kW (11 to 20.9) kW	0.10 % 0.062 % 0.072 % 0.075 % 0.087 % 0.14 %	Fluke 5520A

VI. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
Relative Power – Measure  (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB (-60 to -70) dB (-70 to -80) dB (-80 to -90) dB (-90 to -100) dB (-100 to -110) dB (-110 to -120) dB (-120 to -127) dB  (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB (-60 to -70) dB (-70 to -80) dB (-80 to -90) dB (-90 to -100) dB (-100 to -110) dB (-110 to -120) dB (-120 to -127) dB	2.5 MHz to 1.3 GHz              (1.3 to 26.5) GHz	0.047 dB 0.060 dB 0.074 dB 0.087 dB 0.10 dB 0.096 dB 0.11 dB 0.12 dB 0.13 dB 0.15 dB 0.15 dB 0.28 dB 0.29 dB  0.066 dB 0.060 dB 0.074 dB 0.087 dB 0.10 dB 0.096 dB 0.11 dB 0.12 dB 0.13 dB 0.15 dB 0.15 dB 0.28 dB 0.29 dB	HP 8902A

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
Absolute Power – Measure			
(0 to +20) dBm	9 kHz to 2.0 GHz (2.0 to 13) GHz (13 to 16) GHz (16 to 18) GHz	0.69 % 2.6 % 2.6 % 2.8 %	E4418B power meter, E9304A-H18 power sensor
(-10 to 0) dBm	9 kHz to 2.0 GHz (2.0 to 13) GHz (13 to 16) GHz (16 to 18) GHz	3.1 % 3.1 % 3.1 % 3.3 %	
(-60 to -10) dBm	9 kHz to 2.0 GHz (2.0 to 13) GHz (13 to 16) GHz (16 to 18) GHz	3.6 % 3.7 % 3.7 % 3.8 %	
(-50 to +30) dBm	(18 to 24) GHz	4.1 %	E4418B power meter, U2002H power sensor
Power Meter – Power Reference @ 1 mW	50 MHz	0.69 %	F1130A RF transfer standard, 1830A power meter
Calibration Factor	(0.10 to 0.20) MHz (0.30 to 40) MHz (0.05 to 2.0) GHz (2.1 to 3.6) GHz (3.7 to 4.6) GHz (4.8 to 10) GHz (12 to 18) GHz	0.65 % 0.58 % 0.57 % 0.59 % 0.61 % 0.66 % 0.78 %	Tegam F1130A, 1830A

Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
AM Modulation – Measure			
Rate: (0.05 to 10) kHz Depth: (5.0 to 99) %	(0.15 to 10) MHz	0.024 % depth/% depth + 0.14 % depth	HP8902A
Rate: (0.01 to 10) kHz Depth: Up to 99 %	(0.15 to 10) MHz	0.023 % depth/% depth + 0.11 % depth	
Rate: (0.05 to 50) kHz Depth: (5.0 to 99) %	(10 to 1 300) MHz	0.01 % depth/% depth + 0.15 % depth	
Rate: (0.02 to 100) kHz Depth: Up to 99 %	(10 to 1 300) MHz	0.023 % depth/% depth + 0.11 % depth	
Rate: (0.05 to 50) kHz Depth: (5.0 to 99) %	(1.3 to 26.5) GHz	0.0040 % depth/% depth + 1.2 % depth	
Rate: (0.02 to 100) kHz Depth: Up to 99 %	(1.3 to 26.5) GHz	0.015 % depth/% depth + 1.2 % depth	
FM Modulation – Measure			
Rate: (0.02 to 10) kHz Deviation: ≤ 40 kHz	(0.25 to 10) MHz	0.016 kHz/kHz + 0.0035 kHz	HP8902A
Rate: 50 Hz to 0.10 MHz Deviation: ≤ 400 kHz	(10 to 1 300) MHz	0.0078 kHz/kHz + 0.0035 kHz	
Rate: 50 Hz to 0.10 MHz Deviation: ≤ 400 kHz	(10 to 1 300) MHz	0.039 kHz/kHz + 0.0068 kHz	
Rate: 20 Hz to 0.20 MHz Deviation: ≤ 400 kHz	(1.3 to 26.5) GHz	0.0078 kHz/kHz + 0.0068 kHz	
Rate: 20 Hz to 0.20 MHz Deviation: ≤ 400 kHz	(1.3 to 26.5) GHz	0.039 kHz/kHz + 0.0068 kHz	



Parameter/Range	Frequency	CMC <sup>2, 6</sup> (±)	Comments
Phase Modulation – Measure  Rate: (0.20 to 10) kHz Up to 400 Radians  Rate: (0.20 to 20) kHz Up to 400 Radians  Rate: (0.20 to 20) kHz Up to 400 Radians	(0.15 to 10) MHz  (0.01 to 1.3) GHz  (1.3 to 27) GHz	0.037 rad/rad + 0.036 rad  0.037 rad/rad + 0.036 rad  0.037 rad/rad + 0.036 rad	HP8902A
Reflection S11/S22 – Magnitude  1 to ∞	(9.0 to 300) kHz 300 kHz to 10 MHz 10 MHz to 3.0 GHz (3.0 to 6.0) GHz (6.0 to 8.5) GHz (8.5 to 9.0) GHz	0.0061 lin 0.0079 lin 0.012 lin 0.017 lin 0.023 lin 0.024 lin	Keysight E5080A, 85032F Cal Kit
Transmission S12/S21 – Magnitude  (0 to 60) dB	(9.0 to 300) kHz 300 kHz to 10 MHz 10 MHz to 3.0 GHz (3.0 to 6.0) GHz (6.0 to 8.5) GHz (8.5 to 9.0) GHz	0.054 dB 0.023 dB 0.026 dB 0.067 dB 0.11 dB 0.14 dB	Keysight E5080A, 85032F Cal Kit

## VII. Fluid

Parameter/Equipment	Range	CMC <sup>2, 5</sup> (±)	Comments
Volume – Pipettes	(0.1 to 100) µL (100 to 500) µL (0.5 to 1) mL (1 to 5) mL	0.014 % 40 µL/L 32 µL/L 29 µL/L	Gravimetric calibration using Sartorius balance & ANSI/ASTM E617 Class 1 weights

VIII. Fluid Quantities

Parameter/Equipment	Range	CMC <sup>2, 5, 8</sup> (±)	Comments
Mass Flow – Measuring Equipment	(1 to 5) SCCM	0.25 %	DHI molbox w/molbloc
	(5 to 50) SCCM	0.24 %	
	(100 to 1000) SCCM	0.26 %	
	(1 to 10) SLPM	0.29 %	
	(3 to 50) SLPM	0.25 %	
	(50 to 300) SLPM	0.25 %	
	(120 to 1200) SLPM (400 to 4000) SLPM	0.25 % 0.25 %	
Viscosity Meters <sup>3</sup>	100 cps 1000 cps 12500 cps 100000 cps	0.28 cps 3.4 cps 55 cps 480 cps	Viscosity standard solutions

IX. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 5, 8</sup> (±)	Comments	
Pressure <sup>3</sup> – Measuring Equipment	Hydraulic	(14 to 3000) psia	0.45 psi	Ruska 7615
		(3000 to 6000) psia	0.91 psi	
		(6000 to 10 000) psia	1.5 psi	
	Pneumatic	(0 to 20 000) psi	11 psi	Additel pressure gauges
		(20 000 to 40 000) psi	41 psi	
		(0 to 23) psi	0.085 % + 0.0011 psi	DHI RPM4
		(0 to 50) psi	0.0045 psi	Fluke PPC4
		(50 to 300) psi	0.0055 % + 0.0028 psi	
		(300 to 1000) psi	0.0083 % + 0.027 psi	
		(300 to 2000) psi (2000 to 20 000) psi	0.021 % + 0.041 psi 0.021 % + 0.42 psi	Fluke RPM4-E-DWT

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 8</sup> (±)	Comments
Mass <sup>3</sup>	(0.001 to 6) g (1 to 500) g (5 to 1000) g (0.01 to 40) kg	16 µg 25 µg 2.9 mg 83 mg	Sartorius CCE6 Sartorius CC-500 Sartorius CCE-1201 Sartorius CC-30002
Scales <sup>4</sup>	Up to 500 lbs	0.82R lbs	Class 6 weights
Balances <sup>4</sup>			
0.0001 g Resolution	Up to 500 mg (0.5 to 5) g 5 g to 42 kg	0.83R g 0.91R g 1.2R g	Class 1 and E2 Weights
0.001 g Resolution	Up to 50 g (50 to 100) g (0.1 to 42) kg	0.83R g 0.87R g 1.2R g	
0.01 g Resolution	Up to 1 kg (1 to 42) kg	0.86R g 1.2R g	
0.1 g or 1 g Resolution	Up to 42 kg	0.93R g	
Torque <sup>3</sup> – Measure Wrenches, Screwdrivers & Watches	(1 to 8) ozf·in (8 to 40) ozf·in (2.5 to 10) lbf·in (10 to 50) lbf·in (50 to 250) lbf·in (250 to 750) lbf·in (62.5 to 250) lbf·ft (250 to 1000) lbf·ft	1.2 % 0.63 % 0.57 % 0.77 % 0.63 % 0.65 % 1.2 % 0.71 %	Torque Mate 2000
Torque – Measuring Equipment Transducers	5 ozf·in to 10 lbf·in (10 to 120) lbf·in 120 lbf·in to 100 lbf·ft (100 to 1660) lbf·ft	0.035 % 0.035 % 0.035 % 0.034 %	Torque arms, weights
RPM <sup>3</sup> – Measure	(1 to 3000) RPM	0.11 RPM	Frequency counter w/ IR sensor

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 8</sup> (±)	Comments
RPM <sup>3</sup> – Generate Optical	(1 to 100 000) RPM	0.000 038 rpm/rpm + 0.000 35 rpm	Fluke 5520A w/ LED fixture
RPM <sup>3</sup> – Contact Meters	(1 to 3000) RPM	0.11 RPM + 0.60R	Frequency counter/motor
Air Velocity – Measuring Equipment, Anemometers	(25 to 7500) fpm	1.2 %	Wind tunnel & omega differential pressure sensor, model WT4401S
Force – Measure Tension & Compression	Up to 2500 lbf (2500 to 25 000) lbf  (25 000 to 60 000) lbf	0.34 lbf 3.3 lbf  720 lbf	Morehouse tension & compression  Tinius Olsen Super-L w/computer display
“Direct Verification” of Durometers <sup>3</sup> – Spring Force	A, B, O, D, C, DO scales	0.52 duro points	Durocalibrator
Magnetics – Gauss Meters	54.8 Gauss 995.8 Gauss 4940 Gauss	0.20 Gauss 7.7 Gauss 9.5 Gauss	MII F343-50 MII F062-1K MII F062-5K

#### X. Optical Radiation

Parameter/Equipment	Range	CMC <sup>2, 5, 8</sup> (±)	Comments
Photometric – Measure <sup>3</sup>	(1 to 10 000) fc	4.7 %	Radiometer

XI. Thermodynamic

Parameter/Equipment	Range	CMC <sup>2,4,8</sup> (±)	Comments
Dew Point <sup>3</sup> – Measuring Equipment	(-20 to 60) °C	0.10 °C	Thunder Scientific 1200/2500
Infrared Thermometers – Hart Furnace	(-15 to 0) °C (0 to 100) °C (100 to 120) °C (120 to 200) °C (200 to 350) °C (350 to 500) °C  (500 to 1200) °C	1.2 °C 1.4 °C 1.3 °C 2.1 °C 2.5 °C 2.9 °C  8.1 °C	Fluke 4181/4180  ε = 0.9 to 1.0 λ = (8 to 14) μm  Fluke 9150 furnace w/Hart 1529 & Type S thermocouple
Temperature <sup>3</sup> – Measure & Measuring Equipment	(-80 to 110) °C  (110 to 550) °C (550 to 1200) °C	0.011 °C + 0.60R  0.042 °C + 0.60R 0.59 °C + 0.60R	Fluke 7381 precision bath w/Hart 1594A & 5698 SPRT  Isotech medusa furnace, Fluke 9150 furnace w/Hart 1529 & Type S thermocouple
Humidity <sup>3</sup> – Measuring Equipment	(10 to 95) % RH	0.51 % RH	Thunder Scientific 2500
Humidity – Measure <sup>3</sup>	(10 to 90) % RH (90 to 100) % RH	1.7 % RH 1.8 % RH	Vaisala HumiCap

## XII. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
Frequency – Time Base	10 MHz	0.59 mHz	GPS, 53132A counter
Frequency – Measure	100 mHz to 225 MHz 225 MHz to 20 GHz	0.13 nHz/Hz + 5.8 μHz 91 pHz/Hz + 0.58 Hz	GPS, 53132A counter GPS, 5350B counter
Frequency – Generate	100 μHz to 15 MHz 250 kHz to 4 GHz (4 to 26.5) GHz	0.12 pHz/Hz + 0.37 nHz 0.12 pHz/Hz + 29 nHz 0.12 pHz/Hz + 0.46 mHz	Frequency counters w/ external reference
Stopwatches & Timers	(0 to 19.99) sec/day	0.037 sec/day	Timometer

<sup>1</sup> This laboratory offers commercial calibration service and field calibration service.

<sup>2</sup> Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

<sup>3</sup> This laboratory performs field calibration activities for these parameters. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

<sup>4</sup> In the statement of CMC;  $L$  is the numerical value of the nominal length of the device measured in inches;  $R$  is the numerical value of the resolution of the device in its respective units;  $D$  is the diameter of the device in inches.

<sup>5</sup> In the statement of CMC, percentages are read as percent of reading/output, unless otherwise noted.

<sup>6</sup> The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMC are expressed as either a specific value that covers the full range or as a fraction

or percent of the reading plus a fixed floor specification.

<sup>7</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.

<sup>8</sup> The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.





# Accredited Laboratory

A2LA has accredited

**TRESCAL, INC.**

*Valley View, OH*

for technical competence in the field of

**Calibration**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NC SL Z540-1-1994 and the requirements of ANSI/NC SL Z540.3-2006 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).



Presented this 15<sup>th</sup> day of June 2023

A blue ink signature of Trace McInturff, written over a horizontal line.

Mr. Trace McInturff, Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 2046.01  
Valid to March 31, 2025  
Revised September 5, 2023

*For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.*